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ABSTRACT

This paper presents the development and evaluation of a World Wide Web-based lesson developed to cultivate situated learning. This research employed the quasi-experimental method along with semi-structured interviews to investigate the effects of a Web-based lesson on science learning in the senior high school level. Three classes of second-year students from two senior high schools in Taipei (Taiwan) were selected as the participants for the study. A total of 110 students participated, including 49 males and 61 females. The statistical results indicated that: (1) students' conceptual progress almost reached a significant level before and after the experiment; (2) there were significant differences between male and female students on their conceptual progress before and after the experiment; and (3) most students had positive opinions about the Web-based lesson. Analysis of qualitative data indicated that some students thought that the Web-based lesson, named Lesson Rainbow, provided a daily-life situation that could promote their motivation for learning and help them integrate knowledge. (Contains 22 references.) (Author/MES)

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A Web-Based Lesson with Situated Learning in Senior High School Level

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Abstract

This article presents the development and evaluation of a web-based lesson developed to cultivate situated learning. This research project employs the quasi-experimental method along with semi-structured interviews to investigate the effects of a web-based lesson on science learning in the senior high school level. Three classes of second-year students from two senior high schools in Taipei were selected as the participants for this study. The total participants were 110 including 49 males and 61 females. The statistic results indicated that (a) students' conceptual progress almost reached a significant level ($t=1.98$, $p<0.051$) before and after the experiment, (b) there were significant differences between male and female students on their conceptual progress before and after the experiment ($F=11.48$, $p<0.001$), and that (c) most students had positive opinions about this web-based lesson. From analysis of qualitative data indicated that some students thought that the web-based lesson, named Lesson Rainbow, provided a daily-life situation could promote their motivation on learning and help them integrate knowledge.

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Keywords: Web-Based Learning, Situated Learning, Hypermedia, Science Learning

Introduction

Arising from the popularity of the WWW, education network computer applications have recently become one of the most promising education tools. The Internet provides a variety of tools for acquiring information and for thinking and allowing more students more ways to construct knowledge (Riedling, 1999). This facilitates students developing a broad, deep, and creative understanding of the available information. Based on the research reviews by Berger and others (1994), technology should be applied in fanciful and creative ways to aggrandize cognitive learning for students. These experiences provide the skills that will enable students to live productive lives in the global, digital, information-based future (Dwyer, 1994).

The merging of various types of media allows learners to select their own mode/representation during learning and make associations or links between the various representations. The digitization of media and the rapid growth of networks make the storage and retrieval of digital material, local or remote, possible. Multiple-model instructions meet individual students' needs and make learning efficient and independent. Internet technology can not only integrate the advantages of traditional CAI into instruction but also provide a variety of learning environments from self-directed learning to individual learning, one-to-one interactive learning, group learning, and situational learning (Mason, 1995). With the Internet, students are able to work with current data that are much more up-to-date, and authentic than the material in textbooks. Online resources can help students make connections between their schoolwork and the concerns of people in the real world. In these ways new technologies can make learning and curriculum more generative (Wiske, 2000). Many research have shown that the web-based instructions had positive effects on students' learning motivation, scientific attitude and learning efficiency (Hsu & Thomas, in press; Krajcik, 2000; Edelson, 2001; Hoadley & Linn, 2000). Most of these research concluded that the positive effects came from a careful design on web pages, learning

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materials and web managements. The benefits of web-based instructions are not reaped automatically but only come as a result of careful planning.

In this study, we chose the theory of situated learning as the theoretical base for the development of a web-based lesson, named "Lesson Rainbow". It is because most of teaching contents and processes in the schooling activities do not part from real-life situations. This causes that students can not apply their learning to solve problems in their real life or in their working places. Educational reform in many countries focuses mostly on lifelong learning and transfer of what students learn to real-life situations (Ministry of Education in Taiwan, 1999; National Science Education Standards, 1996). Situated learning emphases that learning occurs in real situations and the construction of knowledge is in the continuous interaction between human and formerly situations (Brown et al., 1989; Lave & Wenger, 1991; McLellan, 1996). This leads students gain synthetic knowledge instead of inert knowledge. Three ways of realistic situations can be used in class: (1) taking students to the real workplace; (2) immersing students in an authentic or similar situation; (3) providing students an anchoring context (McLellan, 1996).

Many researchers suggested that computer hypermedia and networking technology are effective tools to simulate realistic situations when a realistic situation can not be provided in a traditional classroom (Winn, 1993; Hay,1996; McLellan, 1994; The Cognition and Technology Group at Vanderbilt, 1990, 1997; Harley, 1993). If learning activities can make a connection between the real situation and its underlying theory, it is realistic to learners (Moor et al., 1994). If computer multimedia can simulate realistic situation in a meaningful way, it can make learners to immerse in and to feel it realistic. This study attempts to develop a web-based lesson according to the theory of situated learning and to examine how the Internet supports situated learning.

Method

This research project employs the quasi-experimental method along with semi-structured interviews to investigate the effects of a web-based lesson on science learning in the senior high school level.

Participants

The participants for this study were selected from two senior high schools (called as School **A** and School **B**) in Taipei. They were second-year students and their majors were social sciences. There were four classes who enrolled in Earth Science class in School **A** and two of them were randomly chosen as our participants including forty-four males and forty-two females. One of two classes who enrolled in Earth Science class in school **B** were selected randomly as the sample including 16 males and 30 females. Totally, the participants were 132. After excluding invalid data, the number of the valid sample was 110 (49 males and 61 females).

Instrumentation

Besides the web-based lesson (called as Lesson Rainbow), there were other three instruments that were developed to collect data in students' conceptual progress and their opinions about the web-based lesson. All instruments used in this study were validated by the experts. The characters for each instrument are shown as

follows:

1. Lesson Rainbow (The homepage of Lesson Rainbow is shown as Figure 1): McLellan (1996) suggested there are eight key components including in situated learning: stories, reflection, cognitive apprenticeship, collaboration, coaching, multiple practices, articulation of learning skills and technology. Five of them were designed in Lesson Rainbow except for cognitive apprenticeship, coaching, and articulation of learning skills. The mapping between these components and Lesson Rainbow is shown as below (see Table 1):

Figure 1: The Homepage of Lesson Rainbow

Table 1: Mapping between the Components of Situated Learning and the Designs of Lesson Rainbow

Component	The mapping design of Lesson Rainbow
Stories	The designs of the animations display realistic situations about a story about a trip to the northeast coast in Taiwan.
Collaboration	The function of asynchronous online discussion provides students an opportunity to form a virtual learning community for collaborative learning.
Multiple practices	The formative tests following after each unit in the story provide students multiple practices.
Reflection	The electronic notebook which was designed as a learning tool helps students reflect and take notes on what they are learning.
Technology	Hypermedia and network technology display learning materials to students.

2. A Test: A test was conducted to detect students' understanding on the concepts related to rainbow, humidity, and condensation. There were 23 items in the test which was validated and was examined its reliability (The Cronbachα= 0.76) before the formal experiment.
3. A questionnaire: A questionnaire with 34 Likert-type items was used to conduct students' opinions about the design of this web-based lesson. Four dimensions in the questionnaire were the opinions on interface designs, the designs of situations, the design of learning tools and the overall design of Lesson Rainbow. The Cronbachα of the questionnaire was reported as 0.87.
4. The follow-up interviews: A semi-structured interviews were conducted to investigate students' understanding of the relative concepts and to collected their opinions about the lesson. Twenty

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students (8 males and 12 female s) were selected for interviews based on specific purposes. Each student was interviewed for 20 - 30 minutes.

Procedure

This study includes three main stages: (1) The preparation stage (01/2000~11/2000): In this stage, the major work is to develop Lesson Rainbow and instruments. After pilot study, the instruments were validated and revised for the experimental stage. (2) The experimental stage (12/2000~1/2001): The pretest of the concepts was conducted in the week before the experiment. In the experiment, students received a training session for an hour and completed Lesson Rainbow in two hours. After a week of the experiment, the posttest of the concepts and the questionnaire were administrated. Then, the selected students received the follow-up interviews few weeks later because we needed to analyze data and found typical cases for the interviews. (3) The data analysis stage (1/2001~5/2001): Data analysis and concluding remarks were the major jobs in this stage.

Data Analysis

The data were analyzed in several ways. In order to examine if there was a significant difference between before and after treatments, the paired t-test was used to compare the pretest and posttest scores on concepts. A mixed design of repeated ANOVA was used to test the hypotheses stated male students and female students had a significant difference between before and after the experiment. We used descriptive statistics for the analysis of each item in the questionnaire and used Chi square to test if there was a significant difference among the four dimensions (the opinions on the interface designs, the design of situations, the design of learning tools and the overall design of Lesson Rainbow.) in the questionnaire. The collected data was analyzed using SPSS (Statistical Package for Social Science, version 7.0). The assumptions of normal distribution and homogeneity of variance for dependent variables were tested before applying statistic methods, t test and ANOVA. If the dependent variable is not a normal distribution, the significant level is reset to 0.04 in order to reduce Type I error (Stevens, 1996). Qualitative data were coded and summarized to show a deep understanding of students' learning processes and perspectives on Lesson Rainbow.

Results and Discussion

It was hypothesized that there is a significant difference between student pre and post concept tests. For Lesson Rainbow, the mean for the pretest was 16.7 with a standard deviation of 2.32. In contrast, the posttest mean was 17.4 with a standard deviation of 2.45. The result of repeated t-test showed that there was almost a significant difference (at a 0.04 significant level because of the abnormally-distributed scores of tests) between student pretest and posttests on concepts ($t = 1.98$, $p<0.051$; The data is shown in Table 2).

The pretest mean was 16.6 for male students and that for female students was 17.0. In contrast, the posttest mean for male students was 16.5 and that for female was 18.1 (The data is shown in Table 4). The result of mixed design of 2X2 ANOVA showed that there was a significant different between male and female students' performances on the pretest and posttest ($F=11.48$, $p<0.001$; The data is shown in Table 5). Few male students said that the animations in Lesson Rainbow were not as attractive as online games in interviews. Their low

attention on learning materials leaded to their low performances in the posttest. Computer logs also showed that less male students participated in the online discussion than female students did. This may reduce male students' knowledge construction. Both reasons made male students could not learn better than female students.

Table 2: Summary Table for Paired-t test

N=110	Mean	S.D.	t Value	P
Pretest	16.7	2.32	1.98	0.051
Posttest	17.4	2.45		

*p<0.04

Table 3: Descriptive Statistics

	Male(N=49)		Female(N=61)	
	Mean	S.D.	Mean	S.D.
Pretest	16.6	2.22	17.0	2.39
Posttest	16.5	2.55	18.1	2.14

Table 4: Summary Table for Two Way ANOVA

Sources	df	SS	MS	F	Sig
Before &After(A)	1	17.01	17.01	3.22	0.075
Gender(C)	1	63.11	63.11	11.48	0.001
Interaction(A* C)	1	15.79	15.79	2.99	0.087
Residual(A* S)	108	570.20	5.28		
Residual(C* S)	108	593.60	5.50		

*p<0.04; **p<0.01

The data from interviewing the 20 students showed that most students thought the web-based lesson was more interesting than textbooks because of the animations and interactions. The online discussions made students feel more involved in the learning activities. Five of twenty students suggested that the teacher should participate in the online discussion with them because sometimes they did not know how to solve problems without the teacher's scaffolding. A student said in his interview: " *If the teacher could participate in the online discussion, it would increase the interactions and cleared confusions. I would learn better to have the teacher to involve in the online discussion.*" Different students have different needs in a web-based learning environment. Few of them need teachers' assistances because they are lack of skills on communication and reflective thinking. It is advised that the well-trained teachers involve in online communications with students in order to help weak students overcome their obstacles.

Conclusions

The focus of this study was on investigating the effect of a web-based lesson (Lesson Rainbow) developed to cultivate situated learning. The realistic situation served as a bridge to connect students' daily-life experiences and constructing knowledge. Most students had positive opinions about Lesson Rainbow. From interviews, some

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students said that animations for the simulation of authentic situations could promote their learning motivation and immerse them in an interesting context for meaningful learning.

Networked technologies support collaborative work in which the students combine components or work together making successive drafts (Wiske, 2000). Social learning theory emphasizes the value of dialogue and collaboration in helping students develop and articulate their understanding. In order to reach effective cooperation, students need to share ideas, adventure and argue with others so that they can come to reasonable interpretations of the subjects they are studying (Blumfnfeld, et al., 1997). Students can compare the varied views of a topic and enhance cohesive understanding of science from a well-designed online asynchronous discussion In this study, Lesson Rainbow succeeded in helping students knowledge integrating by evoking discussions for searching answers of the questions after realistic situations. When students communicate with others, they retrieve their pre-knowledge and reconstruct concepts. Meaningful learning occurs when students interact with others or environments (Savery & Duffy, 1995). Therefore, online asynchronous discussion designed for a situated learning environment can promote knowledge integration.

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